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Typhlocirolana longimera sp. n. (Crustacea, Isopoda, Cirolanidae) from north-western Algerian ground waters with notes on Algerian *Typhlocirolana*

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Abstract

A new species of hypogean cirolanid isopod, *Typhlocirolana longimera* **sp. n.** is reported and described from a region located in north-western Algeria. *Typhlocirolana longimera* **sp. n.** can be distinguished from all other species of the genus especially by the peculiar shape of the merus of pereiopod I longer than in any other *Typhlocirolana* species, and for the presence of 6 molariform robust conical robust setae, the bottle shape of uropods and the aesthetasc formula of flagellum in antennulae. The presence in the same region of the two already known species *T. fontis* and *T. gurneyi* is also discussed.

Keywords

Ground waters, Crustacea, Cirolanidae, *Typhlocirolana*, Algeria

Introduction

The Cirolanidae is one of the most speciose isopod families, with more than 497 species belonging to 61 genera. Approximately 89 species in 26 genera are inhabiting subterranean waters (Botosaneanu et al. 1986, Botosaneanu and Viloria 1993, Coineau et al. 1994, Holsinger et al. 1994, Botosaneanu 2001, Coineau and Boutin 2015).

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One of the most interesting taxa of cirolanid isopods is the western Mediterranean stygobitic genus *Typhlocirolana* Racovitza, 1905. Widely spread in the area, it has colonized the continental groundwater of Sicily, Iberian Peninsula, Balearic Islands, Tunisia, Algeria and Morocco with several species (Racovitza 1912, Monod 1934, Boutin et al. 2002, Baratti et al. 2004). The genus occurs in the western Mediterranean with ten described species and several as yet undescribed species, whose phylogenetic relationships have been investigated (Baratti et al. 2004) and still need deeper investigation, especially after the recent transfer of the species *T. leptura* Botosaneanu et al. 1985 to a new genus *Botolana* Coineau and Boutin, 2015 (Coineau and Boutin 2015).

During a survey of the subterranean waters of north-western Algeria, several specimens of the *Typhlocirolana* were collected from several wells of the region. Most of the specimens collected in one of the wells were attributed to the already described species *T. fontis* (Gurney 1902) and *T. gurneyi* Racovitza, 1912.

The aim of this paper is to describe a new species of the North African *Typhlocirolana* and comment on the presence of other Algerian species of the genus.

Methods

The specimens were collected (Fig. 1) using Cvetkov's net (Cvetkov 1968) and baited traps. Dissected specimens were pencil drawn and the figures composed using the GIMP 2.8.14 program (Montesanto 2015).

Results

Suborder Cymothoida Wägele, 1989
Family Cirolanidae Harger, 1880

Genus *Typhlocirolana* Racovitza, 1905

Typhlocirolana Racovitza 1905: 74–76; Racovitza 1912: 226–249; Monod 1930: 134, 139–141, 145–153

Typhlocirolana longimera Mahi & Messana, sp. n.
http://zoobank.org/0344B98E-B980-4A7E-B20C-EFF0AE285256
Figs 2–5

Material examined. Holotype: 1♂, 9.8 mm wells in Ghazaouet, north–western Algeria, 35°04'34.53"N, 001°50'11.64"W; April 2011, A. Mahi legit, MZUF Coll. Crust. 4750. **Paratypes:** 3 ♂♂ and 4♀♀ (dissected and mounted on 40 slides), MZUF

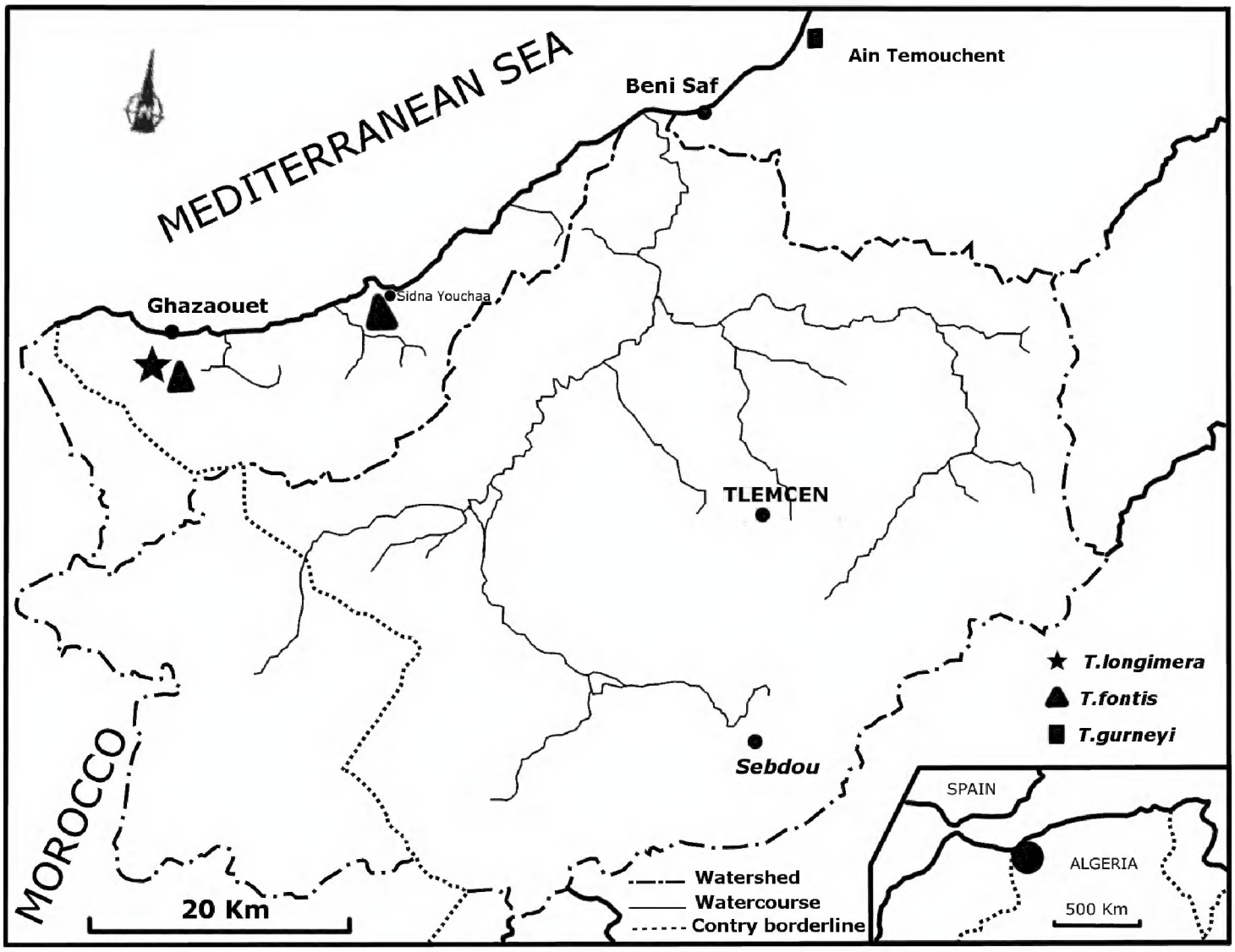

Figure 1. Map showing collection localities of the genus *Typhlocirolana* from the north-western Algeria.

Coll. Crust. 4751; 38 ♂♂ and 129 ♀♀, MZUF Coll. Crust. 4752; 55♂♂ and 2 ♀♀, same locality and collector, coll. Mahi.

Male dimensions. length between 9.8 mm and 10.9 mm.

Female dimensions. length between 10.1 mm and 12.2 mm.

Etymology. the specific name refers to the distinctive shape of the merus of pereopod 1. with its inner margin extending to half of propodite, and thus being longer than in any other species of *Typhlocirolana*.

Description. A small–medium *Typhlocirolana*, epimera II–VII carinate, merus of I pereiopod long, depassing carpus and reaching 2/3 the length of propus, Penial processes about (1/4) length of pereonite 7. Pleotelson triangular, bearing 8–13 short simple setae on distal margin and 5–10 short simple sub-marginal setae (Fig. 2).

Laminia frontalis (Fig. 3g): lanceolate–clavate and strongly tridimensional, laterally flattened, tip rounded. Clypeus: flatly triangular with lateral margins rounded, labrum subrectangular, rounded margins.

Antennula (Fig. 2e): Antennula short, reaching mid-length of pereonite 1. Flagellum shorter than peduncle with 6 articles, with few simple setae, aesthetascs present from second to fourth segment. Aesthetascs formula is 022210 in male and 012220 or 012210 or 011110 in female.

Antenna (Fig. 2d): Antenna reaching the distal margin of pereonite 5, flagellum extending to posterior part of pereonite 4. Flagellum nearly 2 times longer than peduncle, with about 32 segments in male and 35 in female. Segment length regularly decreasing from the base to the apex; all segments with 5 to 9 setae, mainly long and simple setae. 1–3 long plumose setae in each of segment number 4 and 5 of peduncle, and one tufted setae in segment number 4 of peduncle.

Mandibles (Fig. 3a): incisor with three strong teeth in right mandible (Fig. 3a) and 4 in left (Fig. 3b). Lacinia mobilis bearing 13–16 toothed robust setae. Left pars molaris provided with 24 (male) to 33 (female) strong short and regular robust setae.

Palp article 1 with 1 distal simple setae; article 2 with 16–20 setae (2–3 distal long simple setae, 2–4 basal simple setae, 11–13 medial barbed setae); article 3 with 9–11 barbed setae (the 3 last one are longest); article 3 shortest.

Maxillules (Fig. 3d): internal lobe bearing 3 strong and plumose setae and 2 small simple setae. Lateral lobe with 10–11 strong and conical teeth (3 of which toothed) and 2 barbed (on one side) setae.

Maxillae (Fig. 3c): Outer lobe with 3-4 barbed setae on one side in the distal part. Inner lobe with 3–4 similar setae. Basal endite with 9 setae of different lengths, delicately plumose on the two sides and at the tip. Propod with a short simple setae in the middle of distal margin.

Maxilliped (Fig. 3e,f): Palp with 5 articles provided with setae and a well-developed endite with only one coupling hook. Article 1 with one inner simple setae at apex; article 2 with 2 on outer corner margin and 6 on inner margin; article 3 with 4 setae on outer margin and 14–18 on inner margin; article 4 with 2 setae on outer margin and 12 on inner margin (2 of which are plumose in one side); article 5 with 13–17 distal setae, all setae are simple excepted 4–5 which are plumose in one side. Endite with single hook and 4 plumose setae.

Pereiopod 1 (Fig. 4a) Basis with one tufted setae and one simple setulae on outer margin. On inner margin, 2 medial small setae and 2 small setae on distal angle. Ischium 5 setulae, 3 of which on inner margin and 2 distal near outer corner and one spine on inner distal corner. Merus with inner margin elongate, depassing carpus and reaching the 2/3 length of propodus , with 3 setulae on distal outer angle. Inner margin with 6 molariform robust conical robust setae and 2 short, robust setae with additional setule and 1 long simple setae. This armature is constant and similar in male and female. Two to three simple small setae are close to the three proximal molariform robust setae. Carpus with 2 simple setae and 1 single spine with additional setula on distal inner corner. Propodus with inner margin proximally crenulate, with 2 distal spines with additional setula (one which is stronger) and a bunch of 5 apical setae (one of which is barbed on one side). Two simple setae at distal corner on outer margin. One setula on outer side. Dactylus with 5 short setae and 1 spine with additional setula on distal inner corner, 4 subdistal setae on lateral surface.

Pereiopods 2–7 (Fig. 4b–g) similar to each other and progressively growing in length from 2 to 7. Pereopods 2 and 3 exhibit the propodial organ in both males and females. These pereiopods differ by their chaetotaxy, bearing 2 to 5 tufted setae

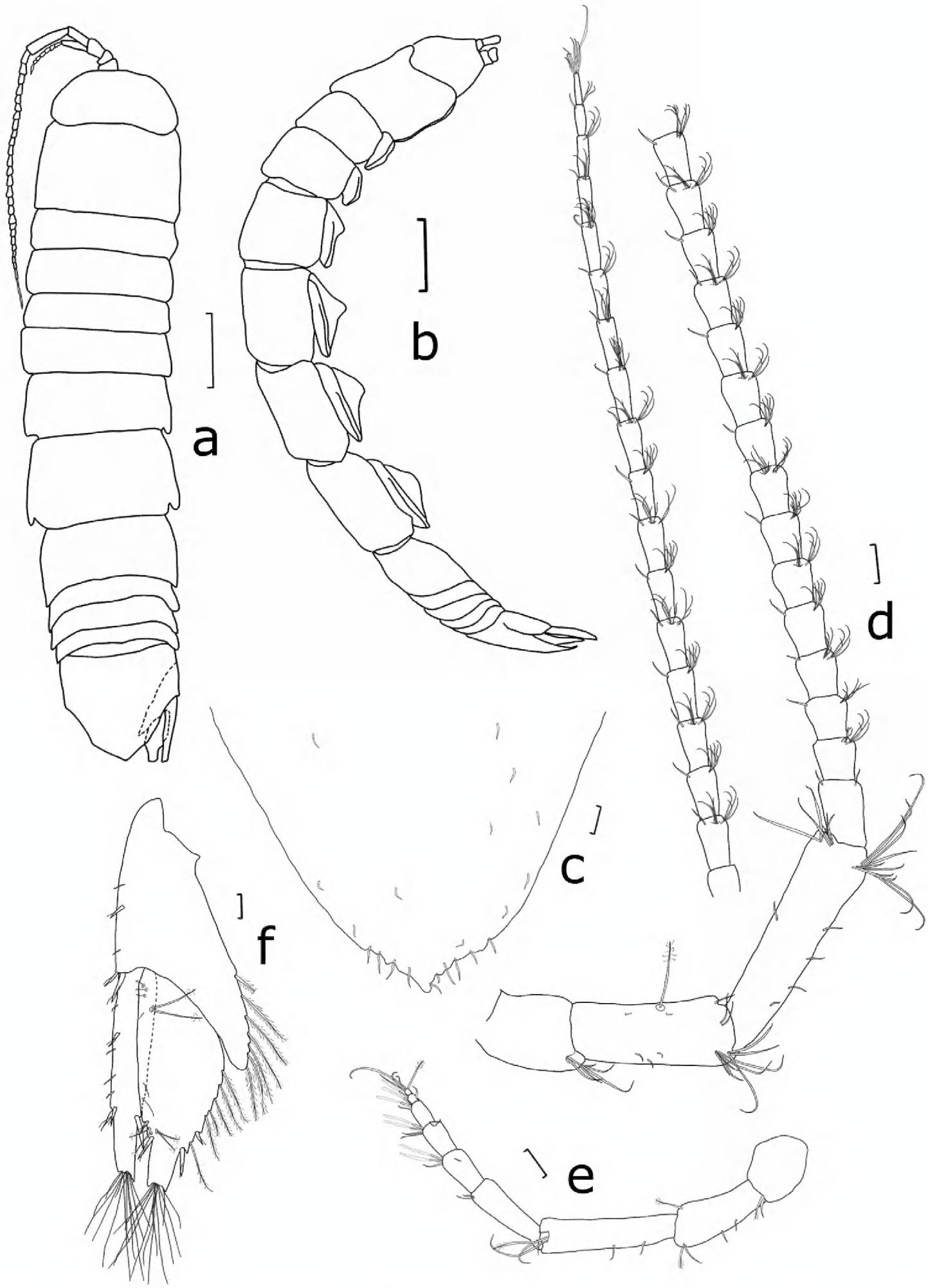

Figure 2. *Typhlocirolana longimera* sp. n. Male. 10.9 mm. **a** habitus **b** lateral view **c** posterior margin of pleotelson **d** antenna **e** antennula **f** uropod. Scale: **a, b** = 1 mm; **c–f** = 0.1 mm.

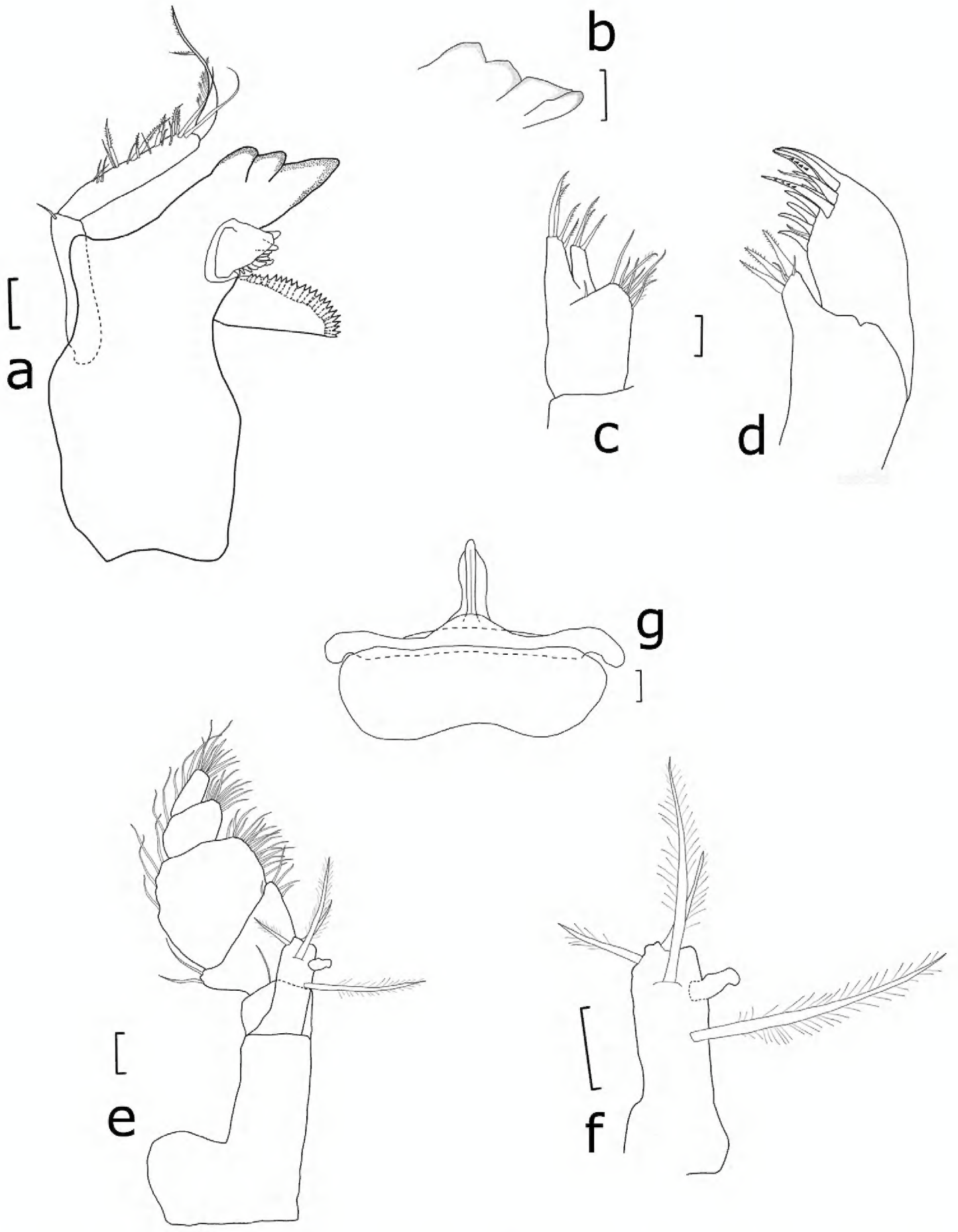

Figure 3. *Typhlocirolana longimera* sp. n. **a** right mandible **b** incisor, left mandible **c** maxilla **d** maxillule **e** maxilliped **f** endite of maxilliped **g** frontal lamina. Scale: **a–g** = 0.1 mm.

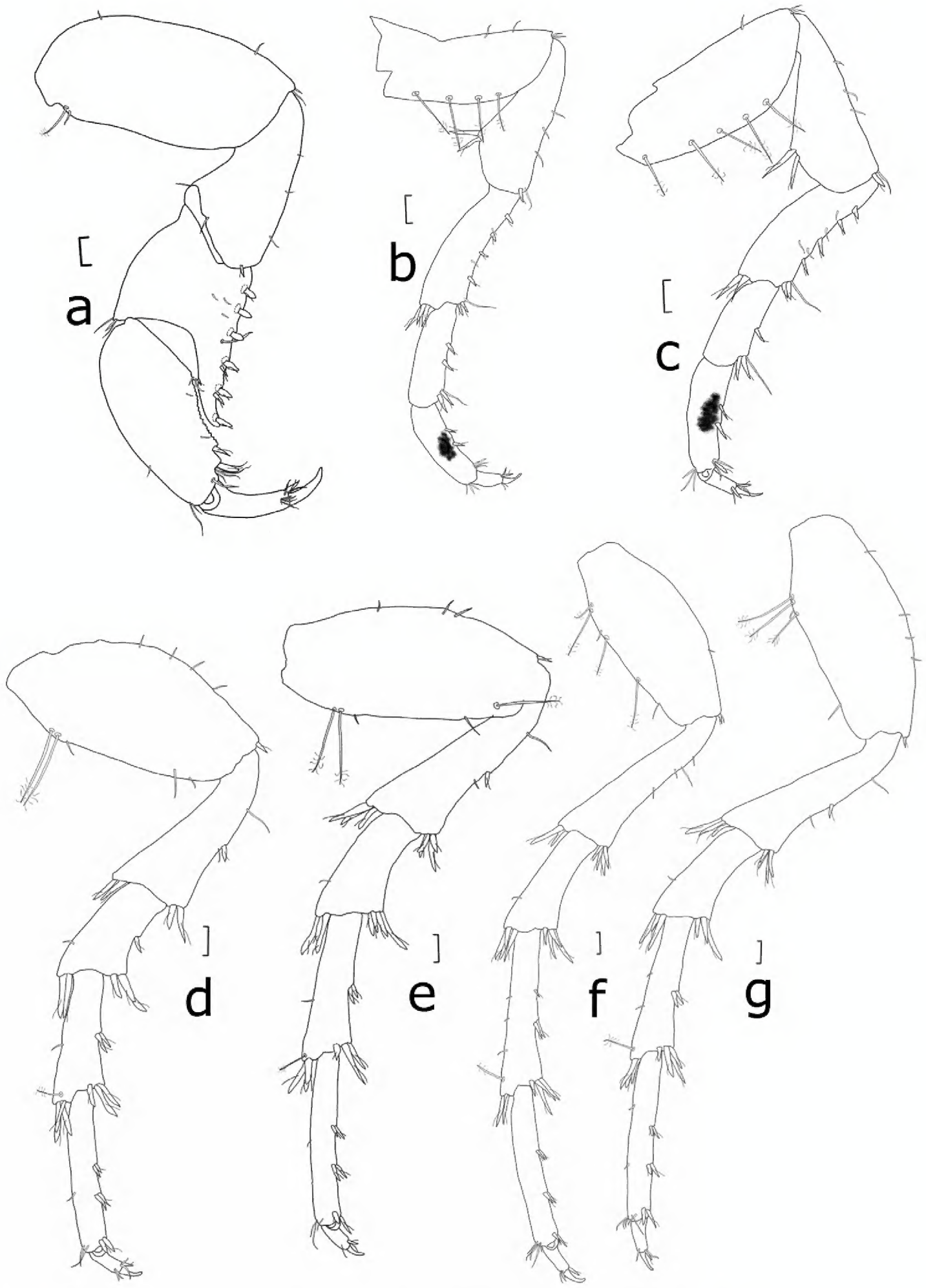

Figure 4. *Typhlocirolana longimera* sp. n. **a–g** pereopods 1–7. Scale: **a–g** = 0.1 mm.

on outer margin of basis; 4–5 along the margin of P2–P3, 2 proximal setae on P4, 2 proximal with 1 distal setae on P5, 4 setae along margin of P6 and 3 proximal setae with penial processes on P7 and about ¼ the length of the same.

Pleopod 1 (Fig. 5a) with 5–8 coupling hooks on subdistal inner margin of sympod, single short and simple seta on outer distal angle; endopod narrower about half than exopod. Endopod with 14–16 plumose setae in male (16–20 in female), exopod with 28–29 plumose marginal setae in male (28–36 in female).

Pleopod 2 (Fig. 5b,c) sympod with 4–6 coupling hooks, and 0–2 plumose setae on lateral subdistal angle, single short and simple seta on distal external angle; exopod oval, with 31–34 plumose setae on distal margin in male and (32–39 in female). Endopod with 9–14 plumose setae. Appendix masculina scimitar shaped externally directed, exceeding exopod by 2/3 of length.

Pleopod 3 (Fig. 5d) sympod with 3–5 coupling hooks and 0–4 plumose seta on inner subdistal margin, single short and simple seta on distal outer angle. Exopod oval, with 24–31plumose setae on distal margin in male (29–37 in female), a few scales and 1–3 short simple setae on inner lateral margin. Transversal suture incomplete.

Pleopod 4 (Fig. 5e) sympod with 2–3 coupling hooks and 1–3 plumose setae on inner subdistal margin, and one simple seta on distal outer angle. Exopod with 8–9 distal inner plumose setae in male (10–11 in female), a few scales pines and 1–2 short simple setae on internal lateral margin, and 0–2 plumose setae on external lateral margin. Transversal suture complete.

Pleopod 5 (Fig. 5f) sympod has one simple setae on distal outer angle; exopod with 5–7 distal inner plumose setae. A few scale-spines and 2–3 short simple setae on inner lateral margin. Transversal suture complete.

Uropods (Fig. 2f) Sympod subtriangular. Lateral margin with 3 spines with additional setula, 1 medial and 2 on distal corner. Two small and simple setae on the outer margin. Seven to eight plumose setae distal on mesial margin in male and 8–12 in female. Exopod styliform, shorter than endopod, regularly slender from base to apex, with 2 strong robust setae with additional setula on lateral margin and 1–2 on mesial margin accompanied by 1 to 2 long simple setae and 1–2 small simple setae; outer margin with 1 small proximal spine with additional setula and one line of 3–4 small simple setae. Apex with about 13 long simple setae of different length. Endopod bottle shaped, clearly wider than exopod. Slightly longer than exopod, with 6 plumose setae on internal margin in male and 5–8 in female and 2–3 strong robust setae with additional setula. Nine tufted setae on external margin grouped by 2 or 3 proximally and distally. Apex bearing about 12 simple distal setae of different lengths.

Remarks. *Typhlocirolana longimera* is different from all other *Typhlocirolana* species described by the combination of the following characters:

- The peculiar shape of pereiopod 1 merus, which is longer than in any other species, depassing carpus and reaching the 2/3 length of propus.
- The presence of 6 molariform conical robust setae and 2 short strong robust setae usually 4 molariform robust setae;

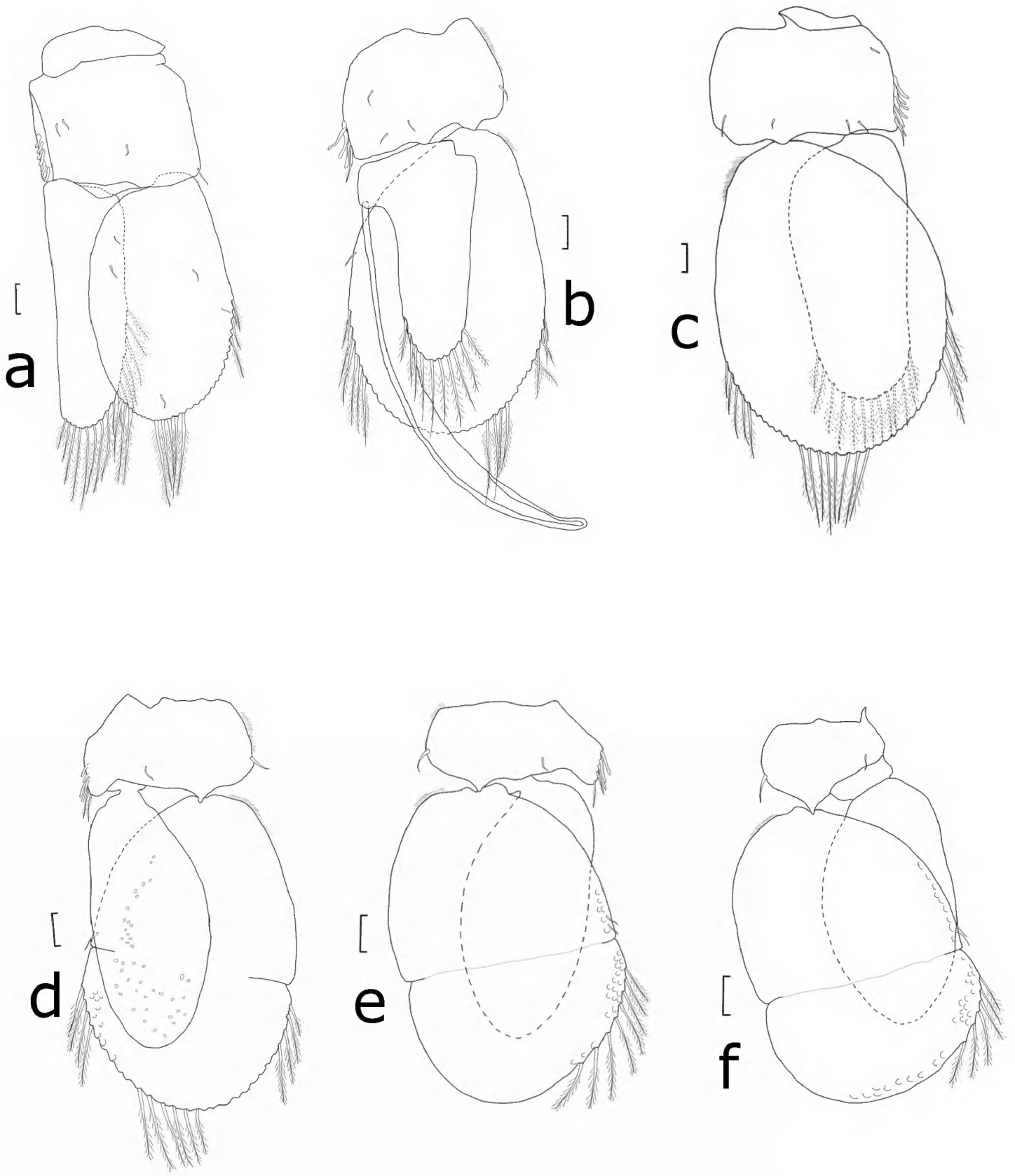

Figure 5. *Typhlocirolana longimera* sp. n. **a** pleopod 1 **b** pleopod 2 **c** female pleopod 2 **d–f** pleopods 3–5. Scale: **a–f** = 0.1 mm.

- Propodus of pereiopod I with only 2 distal robust setae with accessory seta on internal margin, which is proximally crenulated and devoid of setae.
- The bottle shape of uropods;
- The chaetotaxy of pleopods1–5 more abundant.

Differential diagnosis with other materiel examined. Based on the general morphological aspect, as well as some characters, *Typhlocirolana longimera* sp. n. exhibits

the greatest affinities with *T. fontis* and *T. haouzensis* Boutin, Boulanouar, Coineau & Messouli, 2002. However there is a mix of characters approaching *T. longimera* to several other *Typhlocirolana* species.

In addition to the main characters that make the difference with the other species of the genus *Typhlocirolana*, as cited above, *T. longimera* differs greatly from the others according to the aesthetasc formula of flagellum in antennulae: 122222222212 in *T. buxtoni* Racovitza, 1912, 12222212 in *T. fontis*, 12222212 in *T. gurneyi*, 121221 in *T. ichkeuli* Ghlala, Della Valle & Messana, 2009, 22210 in *T. rifana* Margalef, 1953.

Dentition and number of robust setae in propodus of pereopod I: in *T. gurneyi* not toothed with 2 or 3 short strong robust setae, in *T. buxtoni* not toothed with 3 strong robust setae, in *T. fontis* we don't have information, in *T. haouzensis* not toothed with 3 medio distal robust setae, in *T. ichkeuli* not toothed with 3 robust setae.

Propodial organ is present in both male and female in *T. longimera* as well as *T. buxtoni*, but it is present only in the male in *T. fontis*, *T. gurneyi*, *T. haouzensis* and *T. tiznitensis* Boulal, Boulanouar & Boutin, 2009, while, it is absent in *T. ichkeuli*.

The basal palp article of the mandible in Algerian species (*T. buxtoni*, *T. fontis* and *T. gurneyi*) including *T. longimera*, exhibits a strong plumose seta. On the contrary this article is bare in Moroccan (*T. haouzensis* and *T. tiznitensis*) and in the Tunisian species *T. ichkeuli*.

Article III of the mandibular palp has 30 plumose setae in the Algerian species and only 13–16 in the Moroccan one. Whereas, *T. longimera* has an intermediate position with 9–11.

Pleopod 1 exopod of *T. longimera* with 28 or 29 distal setae in male and 28 to 36 in female is different to *T. buxtoni* (40), *T. fontis* (24 in male and 20 in female), *T. gurneyi* (27), *T. haouzensis* (23–26 in male and 27 in female), *T. tiznitensis* (26–30) and *T. ichkeuli* (24–26).

A complete transversal suture is present in pleopod 3, 4 and 5 in Moroccan (*T. haouzensis* and *T. tiznitensis*) and in the Tunisian species (*T. ichkeuli*), while it is present only in pleopod 4 and 5 in Algerian species (*T. buxtoni*, *T. fontis* and *T. gurneyi*) including *T. longimera*.

Uropod shape of *T. longimera* is similar to *T. buxtoni*, *T. fontis*, *T. haouzensis* and *T. tiznitensis*.

Distal margin of the pleotelson with plumose setae in Algerian species (*T. buxtoni*, *T. fontis* and *T. gurneyi*), versus simple setae in *T. longimera* such as Morroccan (*T. haouzensis* and *T. tiznitensis*) and Tunisian species (*T. ichkeuli*).

During several surveys in the years 2010–2013 many specimens of the taxon *Typhlocirolana* where collected in the wells of Ain Temouchent, SidiYouchaa and Ghazaouet, which do not belong to the new described species. In fact the examination of several specimens led us to consider that they are related to the two species described by Racovitza (1912): *T. fontis* and *T. gurneyi*. The examination of these specimens gave the following results:

Typhlocirolana cf. *gurneyi* Racovitza, 1912

Typhlocirolana gurneyi, Racovitza 1912: 261–266, figs 54–63; Monod 1930: 148, 152–155; Nourisson 1956:103, 110–113, 121.

Material examined. Ain Temouchent 8 ♂♂, 4 ♀♀, July 2012, A. Mahi legit, MZUF Coll. Crust. 4753.

Remarks. The specimens of the Ain Temouchent region are most similar to *T. gurneyi* by the shape of uropod that is shallower, the pleotelson bearing 12 long plumose setae on the distal margin in male, 3 strong setae with additional setula on propodus of pereiopod 1 and the endite of maxilliped with 1–2 hooks and 3–4 plumose setae (Fig. 6).

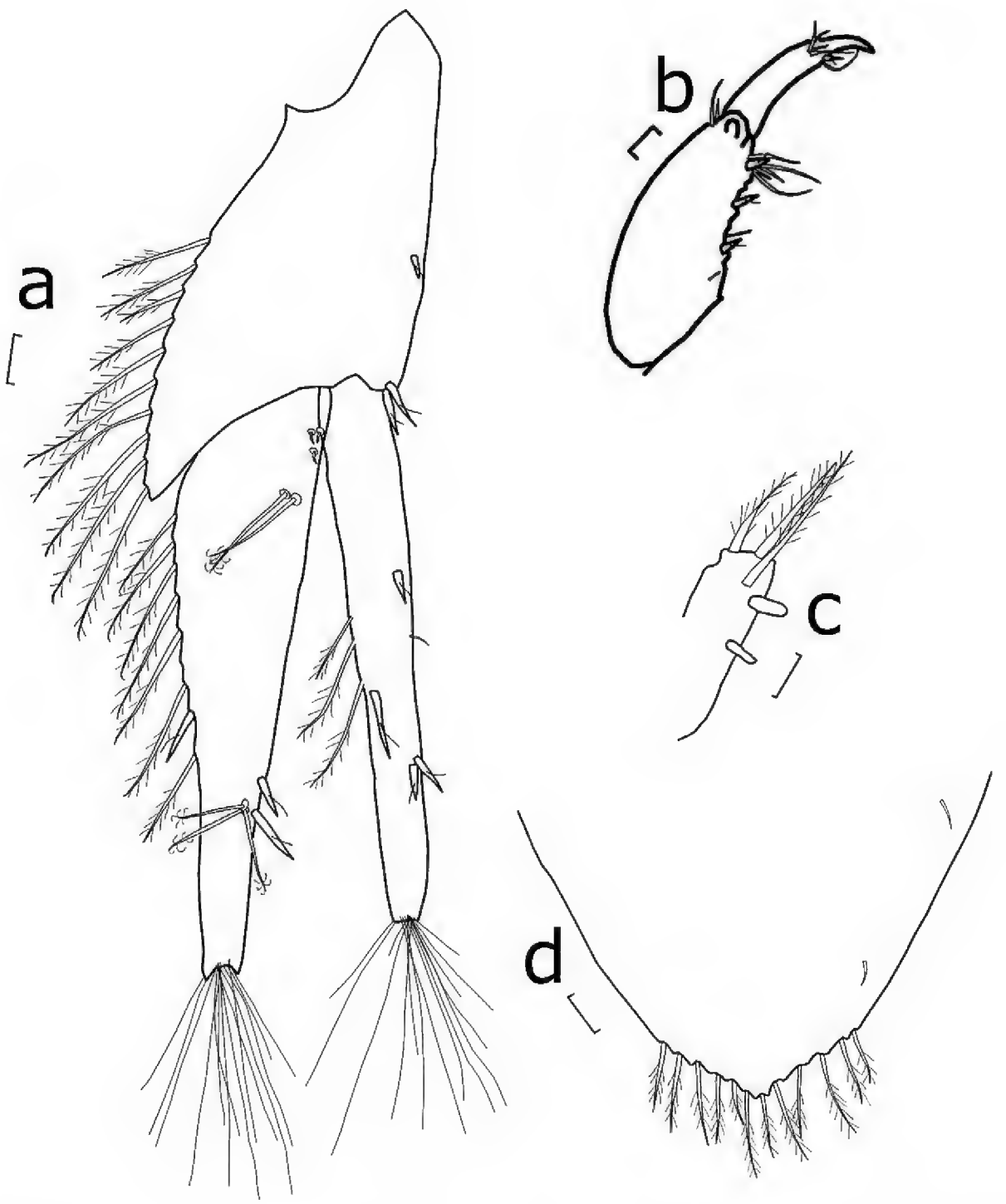

Figure 6. *Typhlocirolana* cf. *gurneyi*. **a** uropod **b** propodus and dactylus of pereopod I **c** endite of maxilliped **d** apex of pleotelson. scale: **a–d** = 0.1 mm.

Typhlocirolana cf. *fontis* (Gurney, 1908)

C*irolana fontis*, Gurney 1908: 682–685
Typhlocirolana fontis, Racovitza 1912: 254–261, figs 49–53 ; Monod 1930: 139, 143, 144, 146–150, 152, 153, 155; Nourisson 1956: 103, 113–116, 121.

Material examined. Sidna Youchaa 181 ♂♂, 138 ♀♀, Octobre 2010, A. Mahi legit; Ghazaouet, 32 ♂♂, 42 ♀♀, date, A. Mahi legit, MZUF Coll. Crust. 4754.

Remarks. These specimens are most similar to *T. fontis* by the presence of propodial organ in male, endite of maxilliped with 1–2 hooks, chaetotaxy of pleopods 1 (19 plumose setae on exopod and 11 plumose setae on endopod of Ghazaouet collection; and 23 plumose setae on exopod and 14 plumose setae on endopod of Sidna Youcha) and pleopod 2 (21 plumose setae on exopod and 7 plumose setae on endopod of Ghazaouet collection; and 26 plumose setae on exopod and 6 plumose setae on endopod of Sidna Youcha) (Fig. 7).

Discussion

The first surveys of the underground aquatic fauna in Algeria run by Gurney (1908) and Racovitza (1912), lead to the discovery of three species of *Typhlocirolana*: *T. fontis*, *T. gurneyi* and *T. buxtoni*. However, Monod (1930, 1934) and Nourisson (1956), argued the status of the two species, *T. fontis* and *T. gurneyi*, suggesting they might be a single species. These authors underline the great variability of the characters used by Racovitza (1912). *Typhlocirolana buxtoni* has been maintained as an independent species probably by the presence of propodial organ in the two sexes (Por 1962). Later, other authors suggest to maintain the separation between the three Algerian species (Botosaneanu et al. 1985, Boutin et al. 2002). We do agree about this point, because we have not enough arguments to separate the three species. On the other hand, we need other new observations for an exhaustive comparison.

The history of *Typhlocirolana* evolution and colonization of subterranean waters, such as that of several other stygobitic crustaceans (Baratti et al. 2010), is the result of multiple vicariance events, which happened in the Mediterranean basin in the last 90–15 MYA. In particular the western Maghreb region has experienced extensive marine ingressions in different periods that allowed a connection between the Tethyan basin and the Atlantic Ocean. The articulated palegeographic history of the region resulted in a complex of species strictly related morphologically and genetically whose position is not easy to elucidate (Boutin et al. 2002, Baratti et al. 2004, 2010, Ait Boughrous et al. 2007, Boulal et al. 2009).

The Algerian situation is rather complicated and will need an accurate revision of the taxa both morphological and molecular. As has been pointed out by other authors (Nourisson 1956), many of the characteristics examined do not correspond to the descriptions that have been given or are common to several species.

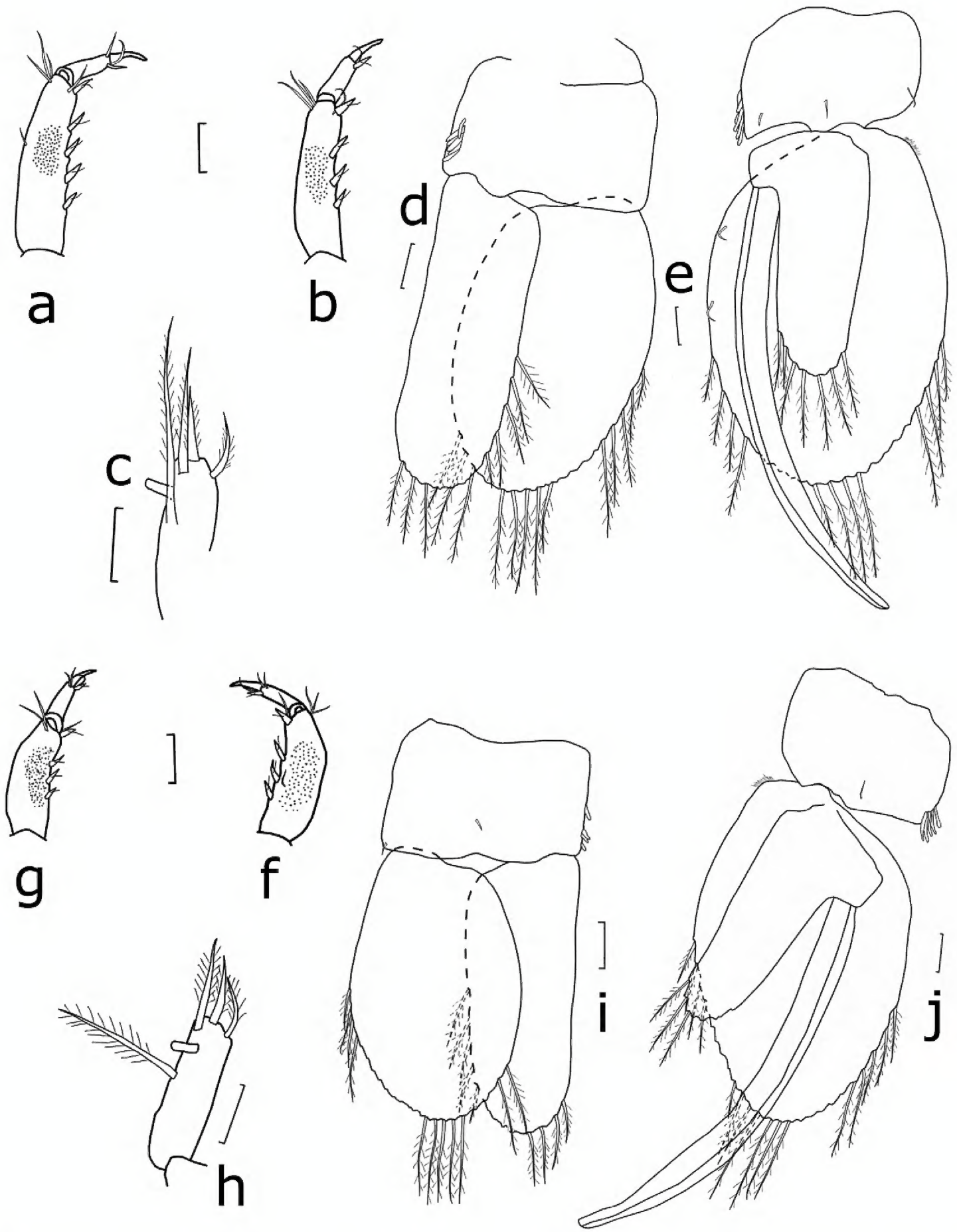

Figure 7. *Typhlocirolana* cf. *fontis*. Ghazaouet (**a–e**): **a** pereopod 1 **b** pereopod 2 **c** endite of maxilliped **d** pleopod 1 **e** pleopod 2 Sidna Youcha (**f–j**): **f** pereopod 1 **g** pereopod 2 **h** endite of maxilliped **i** pleopod 1 **j** pleopod 2. Scale: **a–j** = 0.1 mm. (The armature of pleopods has been partially omitted)

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